SECTION 424

ELECTRICAL CONDUIT

424.1 GENERAL: This work shall consist of furnishing and installing electrical conduit in compliance with the specifications, the details shown on the plans, and Standard Drawings at the locations shown on the plans, or as established by the ENGINEER.

424.2 REFERENCES.

424.2.1 American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications, Latest Edition

422.2.2 American National Standards Institute (ANSI) Standards, Latest Edition

C80.1 Rigid Steel Conduit - Zinc Coated

424.2.3 American Society for Testing and Materials (ASTM) Standard Specifications, Latest Edition

A36 Structural Steel
A307 Carbon Steel Bolts and Studs; 60,000 psi Tensile
D1248 Polyethylene Plastics Molding and Extrusion Materials
D1785 Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120

424.2.4 National Electrical Code (NEC), Latest Edition

424.2.5 Underwriters Laboratories Standards, Latest Edition

UL6 Safety Rigid Metal Conduit
UL651 Safety Schedule 40 & 80 Rigid PVC Conduit
UL1242 Safety Intermediate Metal Conduit

424.2.6 This Publication, Latest Edition

SECTION 501 EXCAVATION AND BACKFILL FOR STRUCTURES
SECTION 701 TRENCHING, EXCAVATION, AND BACKFILL

424.3 MATERIALS

424.3.1 NONMETALLIC CONDUIT: Nonmetallic conduit shall be high-impact poly vinyl chloride (PVC) pipe, Schedule 40, Designation PVC 2110, conforming to the requirements of ASTM D 1785 or high density, Type III polyethylene conduit conforming to ASTM D 1248-6. Conduit and fittings shall comply with the requirements of UL standards (Publication UL 651) and shall be stamped "UL approved." Nonmetallic conduit shall be used only for underground installations.

424.3.2 METALLIC CONDUIT

424.3.2.1 Metallic conduit may be either rigid steel conduit (GRC) or intermediate metallic conduit (IMC). Rigid steel (GRC) shall conform to Underwriters Laboratories UL-6 specification, ANSI C 80.1 and Federal Specification WW-C-581E. Intermediate metallic conduit (IMC) shall conform to Underwriters Laboratories UL 1242 and Federal Specification WW-C-581E. Metallic conduit shall be hot-dipped galvanized to provide a corrosion resistant coating. Fittings shall be watertight and of the same material as the conduit. All conduit installed above ground shall be metallic.

424.3.2.2 Approved expansion couplings shall be provided for all metallic conduit. Expansion couplings shall be as recommended by the manufacturer, designed to compensate for linear thermal expansion of a run of metallic conduit. All expansion couplings shall make a watertight joint.

424.4 CONSTRUCTION REQUIREMENTS.

424.4.1 GENERAL

424.4.1.1 Electrical cable and wire shall be run in conduit except where run inside poles or where the plans show otherwise. All conduit used for underground installations shall be nonmetallic except where encased in concrete, such as bridge decks, or when called for on the plans. The CONTRACTOR may use conduit of a larger size than shown on the plans at no increase in cost provided the larger size is used for the entire run from outlet to outlet. Reducing couplings will not be permitted.

424.4.1.2 The CONTRACTOR shall plan the trenching and conduit placement operation to minimize the open trench and exposed conduit left overnight.

424.4.1.3 Routings of conduit runs shown on the plans are tentative and may be changed by the ENGINEER to avoid underground obstructions. Accurate records of any change from conduit locations shown on the plans shall be kept for preparation of as-built drawings, and the details of altered conduit runs shall be submitted to the ENGINEER

before final acceptance of the project.

424.4.1.4 Excavation (trenching) and backfill for all conduit shall be in accordance with the requirements of Section 701. Conduit shall be laid not less than 30 inches below the finished surface in street and driveway areas, top of curb in sidewalk areas, or natural ground line in unpaved areas. When approved by the ENGINEER, the conduit may be placed at not less than 18 inches below the surface elevation in unpaved median areas, open (natural ground) areas where little future development is expected, or where underground utility conflicts occur at the 30-inch depth.

424.4.1.5 A permanently marked warning tape to indicate the presence of traffic signal conduit shall be placed approximately 12" above the conduit in the backfill.

424.4.1.6 Conduit shall be terminated, stubbed, and capped when required, as shown on the plans or as directed by the ENGINEER. Metallic conduit ends shall be threaded and capped with standard conduit caps until wiring is started. Insulated metal ground bushings shall be provided for threaded ends when caps are removed, electrically connected per the requirements of the NEC. Nonmetallic conduit ends shall be capped until wiring is started.

424.4.1.7 Conduit terminating in pole, cabinet, or pedestal bases shall extend a minimum of 2 inches to a maximum of 4 inches vertically above the bases. Conduit entering a pull box shall terminate 1 inch to 3 inches inside the box wall and 2 inches to 3 inches above the top of gravel sump. Conduit entering through the bottom of a pull box shall be located near the sides and ends of the box so that the major portion of the box will be clear. Conduit shall enter from the direction of the run at all terminal points. Conduit shall enter boxes freely to allow for expansion and contraction. All metallic conduit terminations shall be installed with bushings to prevent wire insulation damage during its installation.

424.4.1.8 Conduit bends, except factory bends, shall have a radius not less than 6 times the inside diameter of the conduit. Where factory bends are not used, conduit shall be bent without crimping or flattening, using the longest radius practical. Metallic bends shall be used for difficult or long conduit runs to prevent damage to the conduit caused by pulling cables.

424.4.1.9 Conduit leading to walls, lights, or to fixtures below the grade of a pull box shall be sealed by a sealing conduit and an approved compound to prevent water from flowing into the fixture.

424.4.1.10 Existing underground metallic conduit to be incorporated into a new system shall be cleaned with a mandrel and blown out with compressed air. Existing nonmetallic conduit shall be blown out with compressed air. If excess amounts of foreign debris are encountered, conduit shall be flushed out with clean water and then air blown as directed by the ENGINEER.

424.4.2 NONMETALLIC CONDUIT

424.4.2.1 GENERAL

424.4.2.1.1 Nonmetallic conduit shall be straight cut, and ends shall be squared and trimmed after cutting to remove rough edges. Connections shall be of the solvent weld type except for connections to metallic conduit where the coupling shall be threaded on the metallic conduit side. Solvent weld connections shall be made according to the recommendations of the conduit manufacturer.

424.4.2.1.2 A bare No. 8 AWG copper conductor shall be run continuously in all nonmetallic conduit for bonding and grounding purposes. This bare conductor shall be installed in accordance with Seciton 426 - Wiring, and be considered incidental to the cost of the conduit.

424.4.2.2 BENDING: One of the following methods may be used to bend nonmetallic conduit:

424.4.2.2.1 An even heat, not to exceed 300 degrees F is applied to a portion of the conduit wrapped in aluminum foil until the desired flexibility is attained. Charring of the conduit shall be kept to a minimum.

424.4.2.2.2 The conduit is inserted into a 4-foot long water-filled steel pipe heated to the temperature required to render the conduit pliable after 30 seconds or longer. The conduit is removed from the hot water, bent as desired, and held in a jig for a cooling period of about 20 seconds.

424.4.2.2.3 The CONTRACTOR may use factory-made bends.

424.4.2.2.4 Bending radii and number of bends shall comply with the applicable requirements of NEC and local codes.

424.4.2.3 EXPANSION COUPLINGS: Expansion couplings shall be installed according to the manufacturer's diagrams and instructions.

424.4.3 METALLIC CONDUIT.

424.4.3.1 GENERAL

424.4.3.1.1 Conduit ends shall be reamed to remove burrs and rough edges. Field cuts shall be true and square so that ends to be joined will butt together for the full circumference. Slip joints or running threads will not be permitted for coupling conduit. When a standard coupling cannot be used, an approved weatherproofed, threaded coupling shall be used. Non-threaded couplings shall be used only when approved by the ENGINEER.

424.4.3.1.2 Conduit threads shall be thoroughly painted with an approved rust-preventive paint before couplings are made up. Couplings shall be tightened until conduit ends are brought together and a good electrical connection is made throughout an entire conduit run. Conduit stubs, caps, exposed threads, and conduit surface areas damaged during handling or installation shall be painted with an approved bituminous or other paint suitable for the purpose.

424.4.3.2 WRAPPED GALVANIZED STEEL CONDUIT

424.4.3.2.1 Galvanized metallic conduit shall be wrapped for rust protection when required by the special provisions or the details shown on the plans. Rust protection shall be applied according to the following requirements:

424.4.3.2.1.1 Conduit surfaces shall be hand wire brushed to remove loose rust and scale, dust, and dirt. Oil and grease shall be removed with a suitable solvent. The surfaces to be coated shall be warmed with a torch to remove moisture.

424.4.3.2.1.2 An approved primer shall be brush-applied to the conduit surface before it has cooled. The protective coating shall not be applied until the primed surface has dried to a tacky consistency.

424.4.3.2.1.3 Tape shall be applied spirally to the conduit.

424.4.3.2.1.4 Galvanized metallic conduit with a PVC jacket coating of 0.025-inch minimum thickness may be furnished in lieu of wrapped galvanized steel. conduit Joints or couplings shall be painted with an approved bituminous paint and wrapped after installation with a minimum of 3 layers of pipe insulation tape of 0.010-inch minimum thickness and covered with mastic compound. Torn, cracked, or scuffed rust protection shall be repaired to the satisfaction of the ENGINEER as specified above. Repair material shall be applied to extend at least 6 inches on each side of the damaged area.

424.4.4 INSTALLATION UNDER EXISTING PAVEMENT

424.4.4.1 Metallic conduit shall be installed under existing pavement by approved jacking or drilling methods. Nonmetallic conduit shall not be installed by jacking. Nonmetallic conduit may be installed by drilling if a hole slightly larger than the conduit is pre-drilled and the conduit is hand-installed. Jacking or drilling pits shall be at least 2 feet from the edge of any type of pavement, measured from the side of the pit nearest to the pavement. Excessive use of water that might undermine pavement or soften subgrade will not be permitted.

424.4.4.2 The ENGINEER may approve relocation of conduit runs or pavement cutting when there is insufficient room for jacking or drilling pits or when underground obstacles are encountered.

424.4.5 CONDUIT FOR STRUCTURES AND FOUNDATIONS

424.4.5.1 GENERAL: An approved coupling as per this Section 424 shall be installed outside the concrete for future connections or removal on a metallic conduit run to a structure or foundation. Non-threaded couplings will not be accepted. If a pull box is located within 24 inches of a foundation, a coupling will not be required outside the foundation. Metallic conduit shall be rust-protected to a minimum of 6 inches inside a concrete structure or foundation. Rust protection will not be required for nonmetallic conduit.

424.4.5.2 BRIDGE STRUCTURES

424.4.5.2.1 Conduit in bridge structures shall be installed as shown on the plans. Conduit to be embedded in concrete for abutments, piers, or bridge decks shall be metallic. This conduit shall be securely attached to the reinforcing steel by approved methods at intervals not to exceed 4 feet. Conduit passing through abutment concrete shall be wrapped with 2 layers of 10-pound asphalt felt building paper, securely taped or wired in place. Conduit leading to soffits, walls, or light fixtures below the pull box shall be sealed by sealing said conduit or other light fixtures with an approved sealing compound. Conduit runs on structure surfaces shall be secured by galvanized malleable iron clamps spaced no more than 5 feet apart.

424.4.5.2.2 EXPANSION FITTINGS: Expansion fittings as detailed on the plans shall be installed where conduit crosses a structure joint. The tubing shall be the same size as the conduit. Expansion fittings shall have a bonding jumper of No. 6 AWG flexible wire or approved equal. Where the ENGINEER determines that expansion

fittings or flexible tubing are not feasible, the conduit shall be installed in a watertight metal sleeve. The clearance between the outside of the conduit and the inside of the metal sleeve shall be ½ inch to 1 inch.

424.4.5.2.3 FLEXIBLE CONDUIT: Liquid-tight flexible conduit may be used between structure sections to accommodate for movement when called for on the plans. The liquid-tight flexible conduit shall be of an extruded polyvinyl jacket over a flexible hot-dipped galvanized core (Type UAG), UL listed and meeting NEC requirements. Liquid-tight flexible conduit may be installed within a concrete pour when approved by the ENGINEER.

424.5 MEASUREMENT AND PAYMENT.

424.5.1 Electrical conduit including expansion fittings and flexible conduits, will be measured by the linear foot complete in place. Measurement will be made parallel to the center line of the installed conduit. Bends and sweeps will be considered incidental.

424.5.2 The accepted quantities of electrical conduit will be paid for at the contract unit price per unit of measurement for each of the pay items listed as shown on the bid proposal.